in death before the missive had reached its destination. He called attention also to the fact that he had observed similar asymmetry in *Mormodes ignea* and had similarly used the terms "right handed" and "left handed." The fact is published in his "Fertilization of Orchids." —J. E. TODD.

University of South Dakota, Vermillion, S. D., Dec. 2, 1895.

VEGETABLE PHYSIOLOGY.

Water Pores.—Dr. Anton Nestler contributes an interesting "Kritische Untersuchungen über die sogenannten Wasserspalten" (pp. 38, pl. 2) to Band LXIV, No. 3 of *Nova Acta d. Ksl. Leop.-Carol. Deutschen Akad. d. Naturforscher.* The term "water pore" was introduced by DeBary to designate a mechanism supposed to be distinguished from ordinary stomata by (1) Presence of liquid water, at least at times, in the substomatic opening; (2) Rigid guard cells; (3) Often very considerable differences in form and size; (4) Location near the edge of the leaf in the teeth over the end of a vascular bundle. The following subjects are considered in this paper: Previous literature; development of the water pores; structure, number, and size; rigidity of the guard cells; plants destitute of water pores. Dr. Nestler shows that water pores originate from stomatic mother cells in the same way as ordinary stomata (48 species of Ranunculus were examined and also plants of many other families); that while water pores sometimes exceed ordinary stomata in size they are quite as often of the same size or smaller, and frequently show plain transitions into the latter; that rigidity of the guard cells is not always present in the water pores nor always absent in ordinary stomata; that water pores sometimes discharge vapor of water; and, finally, that the ordinary stomata sometimes, and probably often, excrete liquid water (over the whole upper surface of the leaf in *Vicia Faba*).—ERWIN F. SMITH.

Biology of Smut Fungi.—The third part of Dr. Brefeld's Smut Fungi (Heft XII of the *Untersuchungen*) contains 140 pages of quarto text and 267 figures packed into 7 lithographic plates, the crowding together of which makes difficult the comparison of text and figures. All told 13 genera and 64 species are described, of which latter 22 are reckoned as new. The germination of the smut spores is figured for most of the species as well as described. The descriptions are long and include a wealth of biological detail drawn from the behavior of the

various forms in Nährlösung. Two new genera are established: Arthrocoidea, founded on two old species (*Ustilago subinclusa* and *U. carycis*), separated from Ustilago by peculiarities of germination, and Ustilaginoidea, a most peculiar genus, founded on Patouillard's *Tilletia oryzæ* and on a new species found by Möller on *Setaria Crus-Ardeæ* in Brazil. Material for the study of the fungus on rice was obtained from Barclay in India. This fungus which causes a swelling of the ovaries of the rice plant to several times the normal breadth of the grain and which has the external appearance of a smut, has nothing to do with Tilletia, but seems to belong to some other group of fungi. Its principal peculiarities are (1) the production of a large number of smut-like spores on the outer part of the transformed grain, the interior of the same being occupied by a hard mass of nonsporiferous hyphæ suggesting an immature sclerotium; (2) germination in a manner totally different from that of any other smut spores and resembling that of some Ascomycetes, i. e. by the development of a much branched septate mycelium which, in dilute Nährlösung, bears succedaneously on the ends of the hyphæ, small, oval, colorless, nongerminating conidia, and in concentrated Nährlösung omits these conidia and develops in their stead and also anywhere on the walls of the hyphæ, sessile dark greenish-black, echinulate, thickwalled spores one in a place or sometimes two together, one above the other. In the species received from Brazil most of the dark spores had fallen off and the development of the central mass of hyphæ had proceeded a step further, being changed into a true sclerotium with a black rind and an internal thickwalled white pseudoparenchyma. Additional facts are promised as soon as these sclerotia can be induced to germinate. The descriptions are followed by a discussion of the relationship of the smuts to each other and to other fungi. A full account of culture methods and some additional notes on fungi are promised for Heft XIII to appear soon.

Incidentally Dr. Brefeld pays his compliments to the perfunctory grinders out of species: "The accidental circumstance that the all naming Patouillard has given to the fungus on rice the name *Tilletia oryzæ* shows once more how worthless are the namings of a spore material without the developmental history. The latter shows that in Patouillard's supposed *Tilletia oryzæ* we have to do not with a Tilletia and not even with a smut fungus but with a form out of the highest group of fungi." This is quite to the point. The labors of the "all naming" mycologists of the past have filled this part of systematic botany with a mass of rubbish mountain high, and still the brave work goes on, exactly as if it were not known that fungi are exceedingly

variable organisms, or that it is possible by holding on to the old notion of fixity of species to make half a dozen new ones out of the product of a single spore by a little variation of the substratum, or even without the latter device by drawing up separate descriptions of old and young and large, small and medium sized spores. Is it not indeed time we should have a reform and begin to *reduce* the number of species by carefully studying those which have been badly described (by far the larger number), learning their life history and the extent of their variability under ordinary conditions, and throwing out the synonyms? This method carefully applied would unquestionably reduce the number of so-called species of fungi and bacteria nearly or quite one-half. This must necessarily form a large part of the work of the next generation of mycologists, and no one familiar with the ground can doubt that the task of properly classifying these plants would be immensely easier if half the descriptions had never been written.—ERWIN F. SMITH.

Function of Anthocyan.—The following is an abstract of a short paper by Prof. Leopold Kny, of Berlin, Zur physiologische Bedeutung des Anthocyans, published in *Atti del Congresso Botanico internazionale di Genova*, 1892 (pp. 135–144). The name anthocyan has been given to a coloring matter occurring in the vegetative and floral organs of many plants in numerous transitional shades from red through violet to blue. It occurs dissolved in the cell sap and is sensitive to acids and alkalies, changing from one shade of color to another as they are used. It is probable that several different substances have been included under this term, for while in most plants these colors appear only on exposure to light, especially bright sunshine, in others they appear just the same in total darkness, e. g. in the perianth of *Tulipa gesneriana*, *Crocus vernus*, and *Scilla siberica*, the inner tissues of the root of the red beet, and the inner leaves of the red cabbage. In case of the floral organs anthocyan undoubtedly serves to make them conspicuous to insects, etc., but for the most part it can have no such function in the vegetative organs. Its use to these parts of the plant has been explained in three different ways. (1) When young leaves and stems either from seedlings or from buds take on a distinct red or violet color and subsequently lose it wholly or in part, it is but a step to the hypothesis that this color has been developed for the protection of the chlorophyll from injury by light. It is explained in this way by Kerner von Marilaun. On this supposition, it is difficult to understand how many young shoots get along without it, e. g. species of Iris, the young leaves of which are bright green. As proof, Kerner makes

prominent the abundance of anthocyan in many alpine plants as well as the fact that when a species grows on the plains as well as in the mountains it is in the latter locality that the vegetative and floral organs show an inclination to become red with anthocyan. (2) In cases where the cells holding the anthocyan are on the under side of the leaf, the upper side being pure green (*Cyclamen europæum, Hydrocharis Morsus ranæ*) the lightscreen hypothesis naturally falls to the ground. Here there is every reason to believe, according to Kerner, that the light rays which would otherwise pass out of the plant and be lost are converted into heat rays in passing through the cells containing anthocyan. In conformity with this hypothesis we find that the leaves of trees and shrubs which are lifted up from the soil and have other green leaves below to catch the filtered light, are never violet on their under surface, while, in very leafy under shrubs, only the lowermost leaves next the ground are provided with anthocyan. Another indication of the warming influence of anthocyan is its abundance in alpine plants, as already mentioned, and its frequent development in the perennial leaves of other plants during the winter season (*Sempervivum tectorum, Ligustrum vulgare, Hedera helix, Mahonia aquifolium*) the leaves being enabled thereby, in sunny winter days, to break up carbon dioxide even at relatively low temperatures. (3) There are, however, a series of facts going to show that the preceding hypotheses are not sufficient to explain all cases. On full grown shoots of many herbs and woody plants the sunny side of the internodes frequently becomes red while the opposite side remains nearly or quite pure green (*Salix* species, *Polygonum fagopyrum*, and many other plants). The same difference is frequently observed on petioles, the red color being not rarely prolonged into the midrib and its branches. These facts lead to the conclusion that the screen of anthocyan may have some use in connection with the breaking up and translocation of plastic substances through the vascular system. This is also indicated by the fact that when the roots of willows and other plants grow down from a bank into the water and are subject to direct sunlight they become red on the exposed surface. Pick considers the anthocyan screen as a means of bringing about the outward movement of starch in large quantities without seriously disturbing the assimilatory activity of the chlorophyll bodies. Some effort has been made to demonstrate this third view, but so far as known, no one has tried to establish the first two by means of experiment. The following experiments were, therefore, undertaken to fill this gap. (1) *Does anthocyan protect chlorophyll from the destructive action of light?* Owing to the manifest difficulty of dealing directly with the chlorophyll bodies the experiments were made

with an alcoholic solution derived from grass leaves. Two beakers were filled with this green solution and placed in tin chambers with blackened inner walls but having on one side a quadrangular opening with strongly projecting edges for the entrance of light. In front of each opening was placed a parallel walled glass vessel 196 millimeters high, 93.5 mm. wide and 40 mm. thick. Into one of these vessels red beet juice was poured and into the other white beet juice, both filtered and of the same specific gravity. The result was decisive. The light which passed through the anthocyan solution discolored the chlorophyll much less rapidly than that which passed through the colorless solution. (2) *Does anthocyan convert the light rays into heat rays?* Experiments were made with the foliage of green and red leaved varieties of the following species, viz. *Fagus sylvatica, Corylus avellana, Berberis vulgaris, Acer platanoides, Brassica oleracea, Dracœna ferrea, Canna indica;* with decoctions of white and red beets; and with the petals of a white and a red rose. Exactly weighed quantities of the leaves, etc., were placed in the parallel walled glass vessels already mentioned, thermometers were then plunged into the center of the mass, and the vessels were exposed to the action of direct sunlight filtered through a nearly saturated alum water screen 4 cm. thick (to absorb the heat rays). In most of the species (*Dracœna ferrea* and *Canna indica* gave contradictory results) the ability of anthocyan to convert light rays into heat rays seems to have been demonstrated conclusively. In one to two minutes in favorable cases there was a rise of temperature in the vessels containing the red leaves, the maximum difference amounting to as much as 4°C. As soon as the sun was covered by a cloud there was a noticeable fall of temperature in both vessels, and when the cloudiness lasted 10 to 20 minutes the temperature became the same or nearly the same in both vessels. Subsequently an effort was made to determine whether the different light rays of the solar spectrum behaved differently. For this purpose three vessels containing, in turn, red leaves of several species of plants were exposed to direct light under the following conditions; the light entering one vessel was filtered through the alum solution, that entering another was filtered through a screen of sulfuric-copper-oxide-ammonia, that entering the third was passed through a solution of bichromate of potash, it having been determined in advance spectroscopically that the two colored screens divided the spectrum in about the middle of the green. Under these conditions the rise of temperature was less behind the blue screen than behind the orange one, and less behind the latter than behind the alum screen. A consideration of the third supposed function of anthocyan is left by Dr. Kny for a subsequent paper.—Erwin F. Smith.